REMARKS

This Amendment responds to the final Office Action mailed February 1, 2007 and is being enclosed with a Request for Continued Examination submitted concurrently herewith. This Amendment represents a submission fully responsive to the final Office Action mailed on February 1, 2007, as required under 37 CFR § 1.114.

Claims 1-6, 8, 10, and 25-28 are pending. Claim 9 has been cancelled. Claims 1-5 and 10 have been amended. In view of the following remarks, as well as the preceding amendments, Applicants respectfully submit that all claims in this application are in complete condition for allowance and request reconsideration of the application in this regard.

Rejections of Claims Under 35 U.S.C. § 102

Claims 25-28 over Nakamoto

Claims 25-28 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Nakamoto (U.S. Patent No. 6,097,138), hereinafter Nakamoto. Of these claims, claim 25 is the only independent claim. The Examiner contends that *Nakamoto* shows or teaches all the elements of the rejected claims. Applicants respectfully disagree for the reasons set forth below.

In contrast to Applicants' claim 25, as amended, *Nakamoto* fails to disclose or suggest "said at least one nanotube positioned in said electrically-conductive layer" and "a dielectric layer coating said length of said at least one nanotube such that said at least one nanotube is electrically isolated from said electrically-conductive layer and said second plate." The Examiner contends that *Nakamoto* discloses an electrically conductive layer (128), at least one nanotube (122) that is positioned in the electrically conductive layer (128), and a dielectric layer (173) coating the length of the at least one nanotube (122) such that the at least one nanotube (122) is electrically isolated from the electrically conductive layer (122) and the second plate (176). The object labeled with reference numeral (173) identified by the Examiner is described by *Nakamoto* as a vacuum discharge space. *See Nakamoto* at column 17, lines 42-44. However, a vacuum discharge space (173) does not coat the length of the nanotubes (122) with a layer, as set forth in Applicants' claim 25 and for reasons set forth below.

According to MPEP § 2111.01, words of the claim must be given their plain (i.e., ordinary and customary) meaning unless a clear definition is provided in the specification. The

plain meaning is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application. The plain meaning of the term "coat" would have been "to cover with a layer, as of paint." *See, e.g.,* The American Heritage Dictionary, 3rd Ed., p. 267. The plain meaning of the term "layer" would have been "a single thickness of a material covering a surface or forming an overlying part or segment." *See, e.g.,* The American Heritage Dictionary, 3rd Ed., p. 770.

The vacuum discharge space (173) is, as the name suggests, a discharge space in which a vacuum environment exists. A vacuum is defined as "a space in which the pressure is significantly lower than atmospheric pressure." *See, e.g.,* The American Heritage Dictionary, 3rd Ed., p. 1488. Space (173) is evacuated so that electrons emitted from the nanotubes (122) are not absorbed by atmospheric gas atoms that would otherwise be trapped in space (173) during processing. Placing space (173) under vacuum optimized the fraction of the electrons emitted from nanotubes (122) that reach the phosphor layer (178) and excite light emission from the phosphor layer (178) that is visible through the transparent electrode (176) and transparent substrate (172).

A person having ordinary skill in the art would understand that the vacuum inside the vacuum discharge space (173) does not form a single thickness of a material covering a surface, as would be required for the vacuum in space (173) to constitute a layer. Logic dictates that the vacuum in space (173) cannot coat the nanotubes (122) in the absence of a layer. Therefore, the vacuum discharge space (173) does not define a dielectric layer that coats the length of the nanotubes, as required by claim 25.

In order for a reference to anticipate the invention in a claim, the reference must teach each and every element in the precise arrangement set forth in the claim. If the reference fails to teach even one of the claimed elements, the reference does not and cannot anticipate the claimed invention. *Nakamoto* fails to disclose "a dielectric layer coating said length of said at least one nanotube," as set forth in Applicants' independent claim 25. For at least this reason, Applicants respectfully request that this rejection be withdrawn.

Because claims 26-28 depend from independent claim 25, Applicants submit that these claims are also patentable for at least the same reasons discussed above. Furthermore, these claims recite unique combinations of elements not taught, disclosed or suggested by *Nakamoto*.

Claims 1, 4-6, 8, and 10 over Farnworth

Claims 1, 4-6, 8, and 10 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Farnworth et al. (U.S. Patent No. 6,858,891), hereinafter *Farnworth*. Of these claims, claim 1 is the only independent claim. Applicants have amended claim 1 to include the subject matter of dependent claim 9, which is not subject to this rejection. Specifically, claim 1 has been amended to set forth "a plurality of semiconducting nanotubes." Before this amendment, claim 1 set forth that the nanotube channel region extended "vertically through said gate electrode." Claim 1 has been further amended to recite that the channel region of "each of said semiconducting nanotubes" extends "vertically through said gate electrode." *Nakamoto* fails to disclose "a plurality of semiconducting nanotubes," as set forth in Applicants' independent claim 9, but instead discloses a single nanotube (22). Consequently, Applicants respectfully request that this rejection be withdrawn.

Because claims 4-6, 8, and 10 depend from independent claim 1, Applicants submit that these claims are also patentable for at least the same reasons discussed above. Furthermore, these claims recite unique combinations of elements not taught, disclosed or suggested by *Farnworth*.

Claims 1, 4-6, 8, and 10 over Choi

Claims 1, 4-6, 8, and 10 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Choi et al. (U.S. Patent No. 6,566,704), hereinafter *Choi*. Of these claims, claim 1 is the only independent claim. Applicants respectfully traverse the rejection. Applicants have amended claim 1 to include the subject matter of dependent claim 9, which is not subject to this rejection. Specifically, claim 1 has been amended to set forth "a plurality of semiconducting nanotubes." Before this amendment, claim 1 set forth that the nanotube channel region extended "vertically through said gate electrode." Claim 1 has been further amended to recite that the channel region of "each of said semiconducting nanotubes" extends "vertically through said gate electrode." *Choi* fails to disclose "a plurality of semiconducting nanotubes," as set forth in Applicants' independent claim 9 and as recognized by the Examiner, but instead discloses a single nanotube (120). Consequently, Applicants respectfully request that this rejection be withdrawn.

Because claims 4-6, 8, and 10 depend from independent claim 1, Applicants submit that these claims are also patentable for at least the same reasons discussed above. Furthermore, these claims recite unique combinations of elements not taught, disclosed or suggested by *Choi*.

Rejection of Claims Under 35 U.S.C. § 103

Claims 2, 3, and 9 over Farnworth

Claims 2, 3, and 9 stand rejected under 35 U.S.C. § 103(a) as unpatentable over *Farnworth*. Of these claims, the subject matter of dependent claim 9 has been introduced into independent claim 1. As the rejection now applies to claim 1, Applicants respectfully traverse the rejection and address the rejection in the following remarks.

Applicants submit that there is no suggestion or motivation to modify the transistor shown in Figure 1 of *Farnworth* in the manner suggested in the Office Action to include multiple nanotubes as the Examiner alleges is taught in Figure 2 of *Farnworth*. In Figure 2, *Farnworth* discloses a plurality of nanotubes (22) in which each of the nanotubes (22) includes a source (40), a gate (46), and a drain (48) in the form of conductive rings to form a transistor structure. Each of the nanotubes (22) in *Farnworth* participates in forming one transistor structure. None of the transistor structures shown in Figure 2 of *Farnworth* includes more than one of the nanotubes (22). Hence, a person having ordinary skill in the art would not perceive from Figure 2 of *Farnworth* that the transistor structure shown in Figure 1 of Farnworth could be modified to include multiple nanotubes. Instead, a person having ordinary skill in the art would replace the single nanotube (22) of the transistor structure in Figure 1 with a single nanotube (22) of the transistor structure shown in Figure 2. In other words, a person having ordinary skill in the art would not change the transistor structure in Figure 1 based upon the disclosure in Figure 2.

Accordingly, there is no suggestion or motivation to modify the structure shown in Figure 1 of *Farnworth* in the manner suggested by the Examiner based upon the disclosure in Figure 2 of *Farnworth*. For at least this reason alone, Applicants submit that the Examiner has failed to establish *prima facie* obviousness as required under MPEP § 2143. Therefore, Applicants request that the rejection of claim 1 be withdrawn.

Because of the deficiencies of *Farnworth*, the Examiner has failed to establish that *Farnworth* teaches or suggests all the claim limitations, as also required under MPEP § 2143.

Specifically, *Farnworth* fails to disclose or suggest "a plurality of semiconducting nanotubes." Instead, *Farnworth* teaches a single nanotube (22) as recognized by the Examiner. For at least this additional reason, Applicants submit that the Examiner has failed to establish *prima facie* obviousness. Therefore, Applicants request that the rejection of claim 1 be withdrawn.

Claim 1 is patentable for additional reasons. Specifically, a person having ordinary skill in the art would understand that the structure shown in Figure 1 of *Farnworth*, even with the modification proposed by the Examiner, fails to disclose or suggest a plurality of nanotubes and that each of the nanotubes includes "a first end physically and electrically coupled with said common source region" and "a second end physically and electrically coupled with said common drain region."

According to MPEP § 2111.01, words of the claim must be given their plain (i.e., ordinary and customary) meaning unless a clear definition is provided in the specification. The plain meaning is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application. The plain meaning of the term "end" would have been "either extremity of something that has a length." See, e.g., The American Heritage Dictionary, 3rd Ed., p. 453. "Extremity" may be defined as "the outermost or farthest point or portion." See, e.g., The American Heritage Dictionary, 3rd Ed., p. 486.

The disclosure in *Farnworth* is subject to more than one reasonable interpretation regarding the shape of nanotube (22) shown in Figure 1. Under one reasonable interpretation, the nanotube (22) in *Farnworth* appears to have an inverted U-shape. Based on the plain meaning of the term "end" and the definition of "extremity," a person having ordinary skill in the art would comprehend that a first "end" of the U-shaped nanotube (22) in *Farnworth* is electrically coupled with the source (17) of device (10). However, the second "end" of the U-shaped nanotube (22) is <u>not</u> physically and electrically coupled with the drain (21) of device (10). Instead, the first and second ends (i.e., the lengthwise extremities) of the nanotube (22) are both physically and electrically coupled with the source (17). Therefore, electrical current <u>cannot</u> flow through the channel region to the second "end" of the nanotube (22) and, then, to the drain (21).

Under another different reasonable interpretation, the nanotube (22) shown in Figure 1 of *Farnworth* may be construed to have the shape of a right circular cylinder labeled with reference numeral 30 (although Applicants cannot find a written description in *Farnworth* of the element labeled with reference numeral 30). Based on the plain meaning of the term "end" and the definition of "extremity," a person having ordinary skill in the art would comprehend that a first "end" of the cylindrical nanotube (22, 30) in *Farnworth* is physically and electrically coupled with the source (17) of device (10). However, the second "end" of the nanotube (22) is not physically and electrically coupled with the drain (21) of device (10). Instead, the second end (i.e., one of the lengthwise extremities) of the nanotube (22) in *Farnworth* projects far above the vertical level of the drain (21). Therefore, electrical current cannot flow through the channel region to the second "end" of the nanotube (22, 30) and, then, to the drain (21).

With regard to Figure 2 of *Farnworth*, each nanotube (22) includes a source (40), a gate (46), and a drain (48) that are ring-shaped. *See* column 5, lines 17-47. Layer (16) is disposed between the bottom end of each nanotube (22) and the ring-shaped source (40). Based on the plain meaning of the term "end" and the definition of "extremity," a person having ordinary skill in the art would comprehend that the bottom end of nanotube (22) is not physically and electrically coupled with the source (40). Similarly, the top end of each nanotube (22) projects above the ring-shaped source (40). Based on the plain meaning of the term "end" and the definition of "extremity," a person having ordinary skill in the art would comprehend that the top "end" of nanotube (22) is not physically and electrically coupled with the drain (48). Therefore, electrical current cannot flow through the channel region to the top "end" of the nanotube (22) and, then, to the drain (48).

For these at least these additional reasons, *Farnworth* fails to disclose that the nanotube includes "a first end physically and electrically coupled with said common source region" and "a second end physically and electrically coupled with said common drain region," as set forth in Applicants' independent claim 1. Accordingly, Applicants request that the Examiner withdraw the rejection of independent claim 1.

Because claims 2-6, 8, and 10 depend from independent claim 1, Applicants submit that these claims are also patentable for at least the same reasons discussed above. Furthermore,

these claims recite unique combinations of elements not taught, disclosed or suggested by *Farnworth*.

The Examiner states in the February 1, 2007 Office Action that Applicants' arguments with regard to claim 1 "are moot in view of the new ground(s) of rejection." Applicants disagree as the Examiner's statement of the rejection over *Farnworth* is identical in the February 1, 2007 Office Action and in the August 3, 2006 Office Action. The Examiner states on page 7 of the August 3, 2006 Office Action that:

> A transistor operates by movement of electrons in the channel region inbetween *(sic)* the source and drain regions. Therefore, two outermost portions of the channel region/nanotube are electrically coupled with the source region and the drain region. Note that a channel region/nanotube is a three dimensional element, and each outermost portion of said element can be considered as an "end."

By way of rebuttal and as the Examiner's statement in the August 3, 2006 Office Action is best understood by Applicants' representative, Applicants believe that the Examiner has erred in his construction of the device (10) disclosed in *Farnworth*. Specifically, the Examiner erroneously considers the entire length of the nanotube in *Farnworth* to be a channel region. When gated, current flows between the source (17) and drain (21) of device (10). *See* column 3, lines 53-66. Current does <u>not</u> flow as a result of gating the channel region in the portion of the nanotube above the drain (21) in Figure 1. Based upon this disclosure in *Farnworth*, a person having ordinary skill in the art would understand that the channel region of the transistor only consists of the <u>portion</u> of the nanotube (22) that is physically between the source (17) and the drain (21).

Applicants agree with the Examiner's statement in the August 3, 2006 Office Action that the nanotube (22) is a three dimensional element. Specifically and as remarked above, the nanotube (22) in *Farnworth* has either a U-shape or the shape of a right circular cylinder. Applicants also agree with the Examiner's statement that the channel region is a three dimensional element. As explained above, one end of the nanotube (22) is either coupled with source (17), if the nanotube (22) is considered to be U-shaped, or projects far above the drain (22), if the nanotube (22) is considered to have the shape of a right circular cylinder.

Consequently and given the plain meaning of the term "end", the nanotube (22) does not have an "end" physically and electrically coupled with the drain (21) under any interpretation of the structures in Figure 1 of *Farnworth*. Electrical current cannot flow through the channel region to the second "end" of the nanotube (22) and, to the drain (21).

Similarly and because the Examiner references column 7, lines 41-42 in *Farnworth*, *Farnworth* discloses a device (70) in relation to Figure 5 that includes a nanotube (22), a source (77), and a drain (83). The nanotube (22) is a right circular cylinder. As indicated by the Examiner in the statement reproduced above, *Farnworth* discloses that current flows through the nanotube (22) between the source (77) and drain (83) to define a channel region between the source (77) and drain (83). However, current does not flow through the length of the nanotube (22) above the drain (83). The channel region in the nanotube (22) does not extend above the vertical level of the drain (83). Instead, one end of the nanotube (22) projects far above the drain (83). Consequently and given the plain meaning of the term "end", the nanotube (22) does not have an "end" physically and electrically coupled with the drain (83). Electrical current cannot flow through the channel region to the second "end" of the nanotube (22) and, then, to the drain (83).

Claims 2, 3, and 9 over Choi

Claims 2, 3, and 9 stand rejected under 35 U.S.C. § 103(a) as unpatentable over *Choi*. Of these claims, the subject matter of dependent claim 9 has been introduced into independent claim 1. As the rejection is now applicable to claim 1, Applicants respectfully traverse the rejection and address the rejection in the following remarks.

Applicants submit that there is no suggestion or motivation to modify *Choi* in the manner suggested in the Office Action. The Examiner admits on page 8 of the February 1, 2007 Office Action that *Choi* fails to disclose "a plurality of semiconducting nanotubes extending vertically through said gate electrode." The Examiner contends that this deficiency can be remedied because of the disclosure in Figure 4B of *Choi*. Applicants disagree with this contention.

In Figure 4B, *Choi* discloses multiple nanotubes (100) arranged in an array such that "a source line and a drain line intersect at locations where the carbon nanotubes are formed to form unit cells." Based upon this disclosure alone, a person having ordinary skill in the art would

understand that Figure 4B discloses that each of the nanotubes (100) is part of a unit cell in which each individual nanotube (100) is coupled with its own drain and each individual nanotube (100) is coupled with its own source. In other words, Figure 4B of *Choi* discloses a plurality of transistors in which each transistor structure includes one nanotube (100). Therefore, Figure 4B of *Choi* fails to disclose a plurality of semiconducting nanotubes each including a first end electrically coupled with a common source region and a second end electrically coupled with a common drain region, as set forth in Applicants' amended claim 1.

Choi discloses at column 5, lines 1-3 that, in comparison with the embodiment shown in Figure 3E, "the second embodiment differs in that the gate 20 is formed between the source 40 and drain 50" and at column 4, lines 33-38 that Figures 4A and 4B show an embodiment that "is the same as the vertical nano-sized transistor according to the first embodiment except that a gate 20 is formed over a drain 50… ." However, *Choi* fails to expressly disclose that the two embodiments differ because the embodiment of Figures 4A, 4B includes multiple nanotubes in each transistor. Hence, a person having ordinary skill in the art would understand that Figure 4B of *Choi* fails to disclose a plurality of semiconducting nanotubes each including a first end physically and electrically coupled with a common source region and a second end physically and electrically coupled with a common drain region.

Accordingly, there is no suggestion or motivation to modify *Choi* in the manner suggested by the Examiner. For at least this reason, Applicants submit that the Examiner has failed to establish prima facie obviousness. Therefore, Applicants request that the rejection of claim 1 be withdrawn.

Claims 25-28 over Nakamoto in view of Jin

Claims 25-28 stand rejected under 35 U.S.C. § 103(a) as unpatentable over *Nakamoto* in view of Jin et al. (U.S. Patent No. 6,250,984), hereinafter *Jin*. The Examiner recognizes that *Nakamoto* fails to disclose that "dielectric 173 is a layer." The Examiner attempts to remedy this deficiency based upon the disclosure in *Jin*. Applicants respectfully traverse the rejection.

Applicants submit that there is no suggestion or motivation to modify *Nakamoto* in the manner suggested in the Office Action. In Figure 11, the Examiner contends that *Jin* discloses a dielectric layer (101A) that coats a nanotube (101A). However, Applicants submit that the

dielectric layer (101A) identified by the Examiner in *Jin* fails to coat the nanotubes (103) that are operating as field emitters of electrons and, as such, there is no motivation to modify *Nakamoto* as suggested by the Examiner.

Jin discloses that a field emitter body in which nanotubes (103) are placed on electrically-conductive layer 104 before layers (100A, 100B, 101A) are formed. *See Jin* at column 14, lines 28-35. Particles (107), which are removed from the final structure, mask regions of the nanotubes (103) during the formation of the layers of a grid structure, which includes layer (101A). *Id.* Because of the masking by the sacrificial particles (107), the nanotubes (103) that operate as field emitters are not covered by layer (101A) when it is deposited. The particles (107) are dissolved after the layers (100A, 100B, 101A) are deposited. *See Jin* at column 14, lines 42-49. Consequently, *Jin* discloses that nanotubes (103) that operate as field emitters of electrons in a field emission display are not coated with the dielectric material of layer (101A). Instead, *Jin* discloses at various locations in the specification that the emitter body is assembled with other known components that maintain "vacuum and structural stability" or with "electrical, vacuum-related, and structural parts." *See Jin* at column 9, lines 2-11; column 10, lines 51-55. A person having ordinary skill in the art would understand from this disclosure in *Jin* that the nanotubes (103) that are not covered by layer (101A) are in a vacuum environment when operating in a field emission display and emitting electrons.

Hence, *Jin* fails to disclose that the vacuum discharge space (173) in *Nakamoto* can be filled with a dielectric layer, rather than filled with a vacuum, and still retain the ability of the nanotubes (122) to operate as field emitters in a field emission display. In fact, *Jin* teaches away from modifying *Nakamoto* to fill the vacuum discharge space (173) with anything other than a vacuum as the regions that will contain electron-emitting nanotubes (103) in *Jin* are deliberately masked by the sacrificial particles (107) when the layer (101A) is applied. For at least this reason alone, Applicants submit that the Examiner has failed to establish prima facie obviousness. Therefore, Applicants request that the rejection of claim 1 be withdrawn.

According to MPEP § 2143.01, "if proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). Replacing the vacuum in the vacuum discharge space (173) in *Nakamoto* with

a dielectric layer, as the Examiner alleges is disclosed in *Jin*, would render the *Nakamoto* field emission display unsuitable for its intended purpose. The nanotubes (122) in *Nakamoto* could not emit electrons if covered by a dielectric layer. A person having ordinary skill in the art would not be motivated to modify *Nakamoto* to make an inoperable field emission device. For at least this additional reason, Applicants submit that the Examiner has failed to establish *prima facie* obviousness. Therefore, Applicants request that the rejection of claim 25 be withdrawn.

Because claims 26-28 depend from independent claim 25, Applicants submit that these claims are also patentable for at least the same reasons discussed above. Furthermore, these claims recite unique combinations of elements not taught, disclosed or suggested by the combination of *Nakamoto* with *Jin*.

Conclusion

Applicants have made a bona fide effort to respond to each and every requirement set forth in the Office Action. In view of the foregoing remarks, this application is submitted to be in complete condition for allowance and, accordingly, a timely notice of allowance to this effect is earnestly solicited. In the event that any issues remain outstanding, the Examiner is invited to contact the undersigned to expedite issuance of this application.

Applicants do not believe fees are dues in connection with filing this communication. If, however, any fees are necessary as a result of this communication, the Commissioner is hereby authorized to charge any under-payment or fees associated with this communication or credit any over-payment to Deposit Account No. 23-3000.

Respectfully submitted,

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Date

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